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Original Research Article

Effect of Ultrasound Guided Fascia Iliaca Block and Pericapsular Nerve Group [PENG] For Positioning and Postoperative Analgesia Prior to Spinal Anaesthesia for Hip Surgeries

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ABSTRACT

Background
Ideal positioning for spinal anesthesia is not possible in hip fracture Surgeries due to extreme unbearable pain. Fascia Iliaca compartment block (FICB) and pericapsular nerve group (PENG) are novel regional analgesic methods, where it's efficacy is not well established. We studied the effect of USG guided FICB and PENG block in control of pain for positioning for Sub-arachanoid block and post operative analgesia.

Methods
A prospective, randomized, double blinded study, which recruited 40 patients of age 18 to 80 years undergoing hip surgeries. Patients were divided into 2 groups of 20 each, as group FICB who received fascia iliaca compartment block and group PENG, who received pericapsular nerve group block. Group FICB (n=20) and group PENG (n=20) both received injection 0.25% Bupivacaine 25ml respectively, by USG guided landmarks. Pain scores were assessed before and after the block, during positioning for Sub-arachanoid block (SAB) and post operative period. Data analysis done by student's 't' test, chi-square tests.

Results
There was no statistically significant difference in VAS scores between two groups during positioning after the block. In group FICB, mean VAS before block was 5.55±0.83 reduced to 0.50±0.61 during positioning and in group PENG it was 5.65±0.67 reduced to 0.75±0.72 during

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positioning for SAB. Mean total duration of analgesia in FICB was 407±125.65 minutes and in PENG was 565.5±155.67 minutes, which is statistically significant.

Conclusion

In hip fracture surgeries, FICB and PENG block both are effective analgesia methods for positioning, whereas PENG block is a better method of analgesia for post operative pain than FICB without any significant side effects.

Keywords: Ultrasound, pericapsular nerve group block, Fascia iliaca compartment block, hip surgeries.

INTRODUCTION

Hip fractures are a common orthopaedic condition in the geriatric population and are associated with excruciating pain that makes it difficult to position oneself for spinal anaesthesia.[1,2] Regional anaesthesia is preferable over general anaesthesia because older patients often have comorbidity issues.[3] Regional anaesthesia is associated with less mortality and morbidity following fracture hip surgeries than general anaesthesia.[4] Placing a patient for spinal anaesthesia is very unpleasant, necessitates larger sedative and narcotic doses, and is not recommended for elderly individuals.[5]

Opioids were the most often used form of treatment for orthopaedic pain. Opioid use in older people has been associated with a variety of complications, though, including hypotension, delirium, extended hospital stays, respiratory depression, or post-discharge adverse effects like dependence or addiction.[6] Regional nerve blocks offer faster onset of action, site-specific analgesia that is more effective than standard systemic analgesia alone in managing hip fracture pain.

When compared to systemic opioids, peripheral nerve blocks (PNB) were found to have less of an influence on hemodynamic, respiratory function, and consciousness.[7] Importantly, PNBs are advised as the primary analgesia treatment for hip operations due to its ability to minimize opioid doses, improve postoperative recovery, and lower the risk of pneumonia.[8] The femoral, lateral cutaneous, and obturator nerves of the thigh are three of the primary lumbar plexus nerves of the thigh, and they are found in the fascial iliaca compartment, one of the most frequent PNB locations, located in the compartment between the iliopsoas muscle and the fascia iliaca.

In concept, the fascia iliaca compartment block (FICB), which is safe and efficient, can simultaneously block the femoral nerve, lateral femoral cutaneous nerve, and obturator nerve to achieve the distal lumbar plexus block effect in patients with hip fractures.[9] However, a disadvantage of the block is the associated motor weakness of the surgical limb which can delay the recovery[10] and it has been reported that in some cases FICB only provide modest analgesia due to the failure of FICB to block the accessory obturator nerve.[11]

In 2018, Girón-Arango et al.[12] acknowledged the anterior capsule as the hip joint's most nerve-rich region and developed the pericapsular nerve group (PENG) block using ultrasonography for blocking the articular branches that commute to the anterior capsule of the hip where they cross the iliopectineal eminence[13]. Yet there haven't been any studies contrasting FICB and PENG. Thus we hypothesised that PENG provide superior analgesia when compared to FICB for hip fracture patients and thus ease of positioning due SAB and provides superior post operative analgesia.

The primary objective was to study the efficacy of USG guided FICB technique and USG guided PENG block technique in ease of positioning the patient for SAB undergoing surgery for hip fracture and the secondary objective was to assess the duration of post operative analgesia by the two techniques of block.

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MATERIALS AND METHODS

After obtaining institutional ethics committee clearance (reference No. EC-139) and CTRI registration (CTRI/2022/06/043027), the study was conducted from June 2022 to September 2022 in Dr. B. R. Ambedkar medical college and hospital. Informed written consent was taken for the patient participating in the study.

As per previous studies, considering power as 80%, alpha error of 0.05, 18 patients per group was obtained. To avoid study errors and possible dropouts sample size of 40 with 20 patients per group were considered. All patients between age 18 years to 80 years with hip fracture scheduled for surgery under SAB were included in this study. Patients who refusing to participate in the study, any contraindications for SAB, who could sit comfortably, coagulopathy, infection at the site of block, local anaesthetic allergy were excluded from the study.

Computer generated random numbers and group assignment was done by sequentially numbered opaque envelopes. The envelopes were opened just before the procedure by the anaesthesiologist performing the block and divided into two groups. The anaesthetist performing the block was not blinded to the procedure, the patient and assessor of VAS were blinded to group allocation. On arrival of the patient to the operating theatre standard monitors such as electrocardiogram, non-invasive blood pressure and pulse oximetry were attached. Pre-procedure pain was assessed and recorded by visual analogue scale (0 = no pain, 10= maximum pain). Regional block was performed with the patient in supine position. The site to be blocked was painted with 10% povidone iodine and draped. Linear high-frequency ultrasound probe (6 - 13 mHz) was initially placed in a transverse plane over the anterior superior iliac spine (ASIS) and then aligned to identify the following landmarks:

Group FICB [Fascia Iliaca Block] – received Bupivacaine 0.25% 25ml. Landmarks included Internal oblique muscle, sartorius muscle, iliacus muscle and bone, fascia lata, fascia iliaca. Point of injection was between fascia iliaca and iliacus muscle.

Group PENG [Peng Block] - received Bupivacaine 0.25% 25ml. Landmarks included Anterior inferior iliac spine, ilio-pubic eminence, iliopsoas muscle and tendon, the femoral artery, and Pectineus muscle. Point of injection was musculofascial plane between the psoas tendon and ilio-pubic eminence.

After the block, patients were continuously monitored by non-invasive blood pressure every 5 minutes, continuous ECG and pulse oximetry. VAS score was noted at the time of positioning. If any patient of either group reported pain score of ≥ 4 during positioning, IV fentanyl 0.5microgram/kg was given and excluded from the study. Quality of patient positioning was assessed by the anaesthetist giving spinal anaesthesia (1 = not satisfactory, 2 = satisfactory, 3 = good, 4= optimal). Spinal anaesthesia was given in either midline/paramedian approach at the L3/4 or L4/5 level, with bupivacaine 0.5 % heavy 3ml (15mg) using 25G Quincke needle. Vital parameters were noted at regular intervals. Patient was shifted to post anaesthesia care unit (PACU) after the surgery. VAS scores were recorded at 0, 2hr, 4hr, 6hr, 8hr, 10hr, 12hr, 16hr, 20hr and 24 hrs along with vital parameters. Time of mobility was noted. Duration of analgesia was calculated from the time of giving the block till VAS score was ≥ 4. Tramadol 1mg/ kg IV was given as rescue analgesic if VAS ≥ 4 in postoperative period. Total doses of consumption of tramadol in first 24hours was noted. Complications if any were documented and appropriately treated.

Statistical Analysis

Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was represented as Frequencies and proportions. Chi-square test or Fischer's exact test (for 2X2 tables only) was used as test of significance for qualitative data.

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Continuous data was represented as mean and standard deviation. Independent t test or Mann Whitney U test was used as test of significance to identify the mean difference between two quantitative variables and qualitative variables respectively.

Graphical representation was done using bar diagram and line diagram.

p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software: MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyse data.

RESULTS

Forty patients were included in the current study. The demographic data of both the groups are presented in Table 1. There was no statistically significant difference in both groups with respect to demographic characteristics.

	Group FICB (n=20)	Group PENG (n=20)	P value
Age (years)	60.45±15.01	58.80±11.69	0.700
Weight (kgs)	62.35±9.40	69.60±7.59	0.011
Male	12	10	0.525
Female	8	10	
ASA I	12	8	0.206
ASA II	8	12	
Duration of surgery (mins)	124±25.32	140.50±28.51	0.060

Table 1: Demographic characteristics

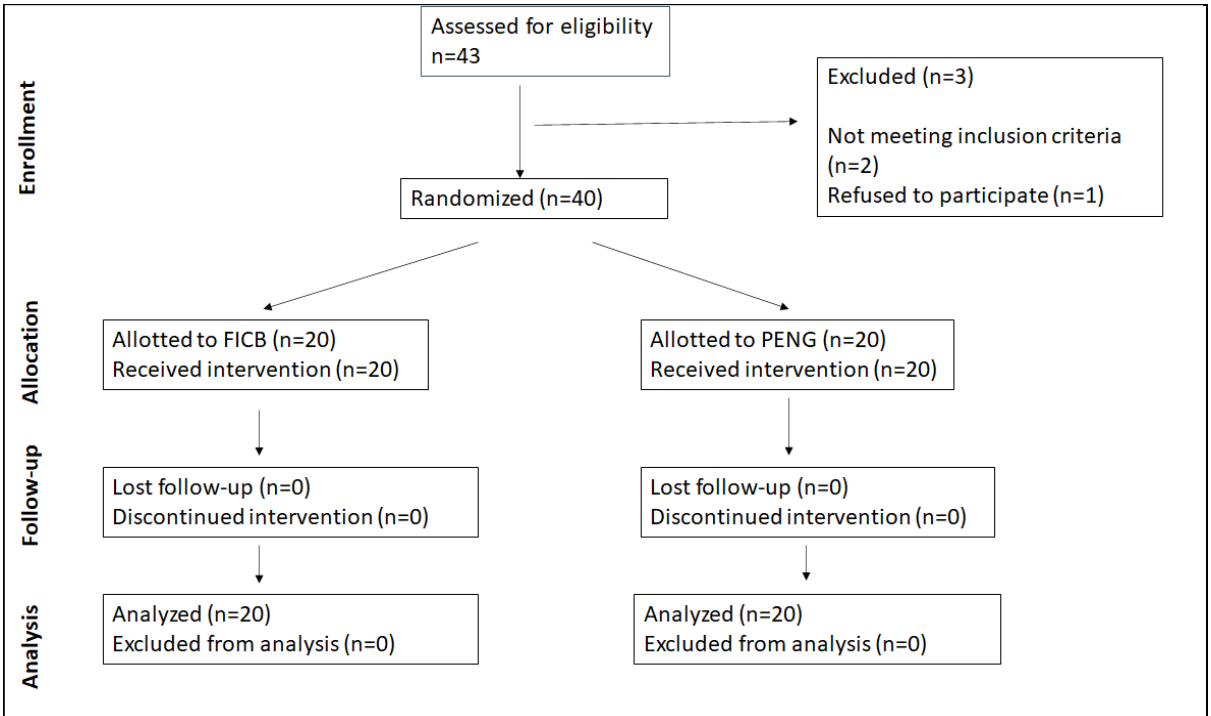

Figure 1: CONSORT flow diagram for enrolment, group allocation, follow-up and analysis

There was no significant difference in VAS scores between two groups during positioning after the block. In group FICB, mean VAS before block was 5.55±0.83 reduced to 0.50±0.61 during positioning and in group PENG it was 5.65±0.67 reduced to 0.75±0.72 during

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positioning for SAB Table 2. There was no significant difference in patient satisfaction score distribution between two groups, where 19 patients in each group were satisfied with the block for positioning for SAB in each group Table 2.

VAS	Group				p value
	FICB		PENG		
	Mean	±SD	Mean	±SD	
Pre-Op	5.55	.83	5.65	.67	0.677
05 Min	2.85	.88	4.60	.68	< 0.001*
10 Min	1.95	.76	3.10	.72	< 0.001*
15 Min	1.10	.55	1.90	.79	0.001*
Positioning for Spinal Anaesthesia	0.50	.61	0.75	.72	0.241

Table 2: Mean VAS Comparison between two groups at different intervals of time

VAS	Group				p value
	FICB		PENG		
	Mean	±SD	Mean	±SD	
Post-Op Baseline	0.60	.68	0.10	.31	0.005*
02 Hours	0.75	.64	0.50	.51	0.180
04 Hours	1.65	.93	1.05	.69	0.026*
06 Hours	2.25	1.07	1.70	1.13	0.122
08 Hours	2.00	.86	1.60	.88	0.154
10 Hours	1.80	.70	1.95	1.05	0.597
12 Hours	2.05	1.05	2.15	1.14	0.774
16 Hours	1.80	1.01	2.20	1.11	0.239
20 Hours	1.50	1.00	2.30	.98	0.015*
24 HOURS	1.20	1.01	2.55	1.00	< 0.001*

Table 3: Mean VAS Comparison between two groups at different intervals of time Post operatively

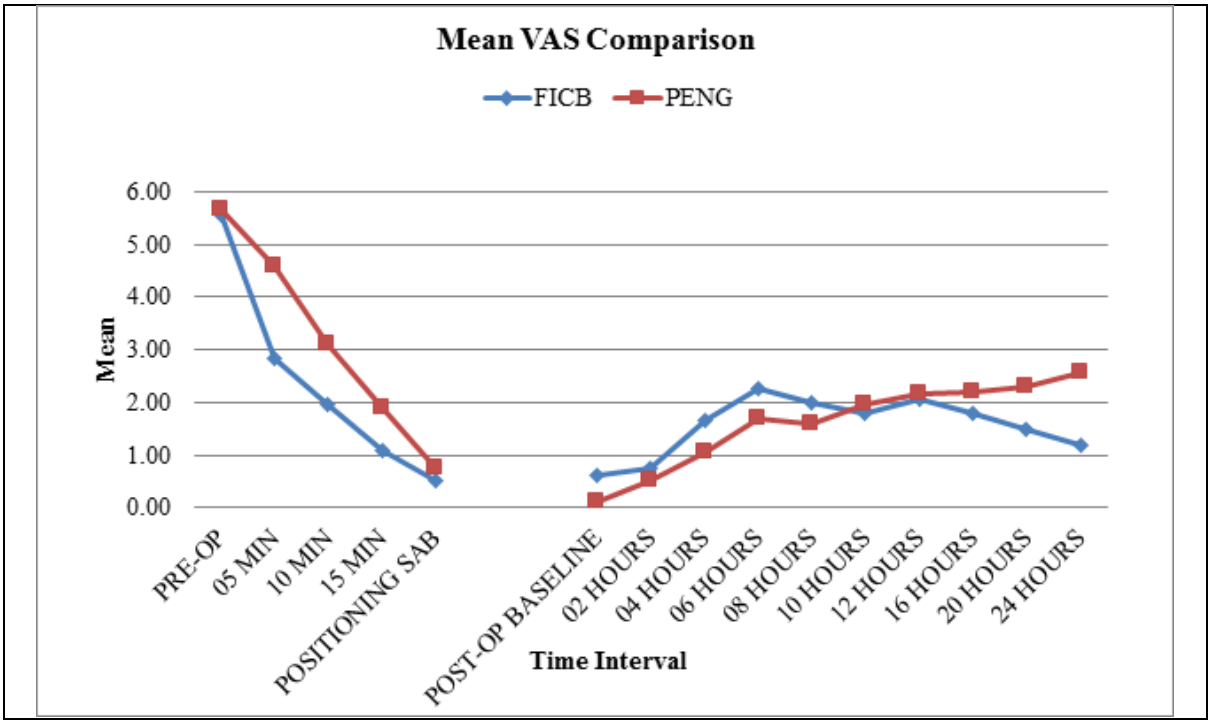

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Figure 2: Line diagram showing mean VAS comparison between two groups at different intervals of time

		Group			
		FICB		PENG	
		Count	Column N %	Count	Column N %
Patient Satisfaction Score	1	1	5.00%	1	5.00%
	2	4	20.00%	8	40.00%
	3	10	50.00%	9	45.00%
	4	5	25.00%	2	10.00%

Table 4: Patient Satisfaction Score Distribution between two groups

Haemodynamic variables i.e., heart rate, mean arterial pressure, SpO2 were compared in both groups which is shown below.

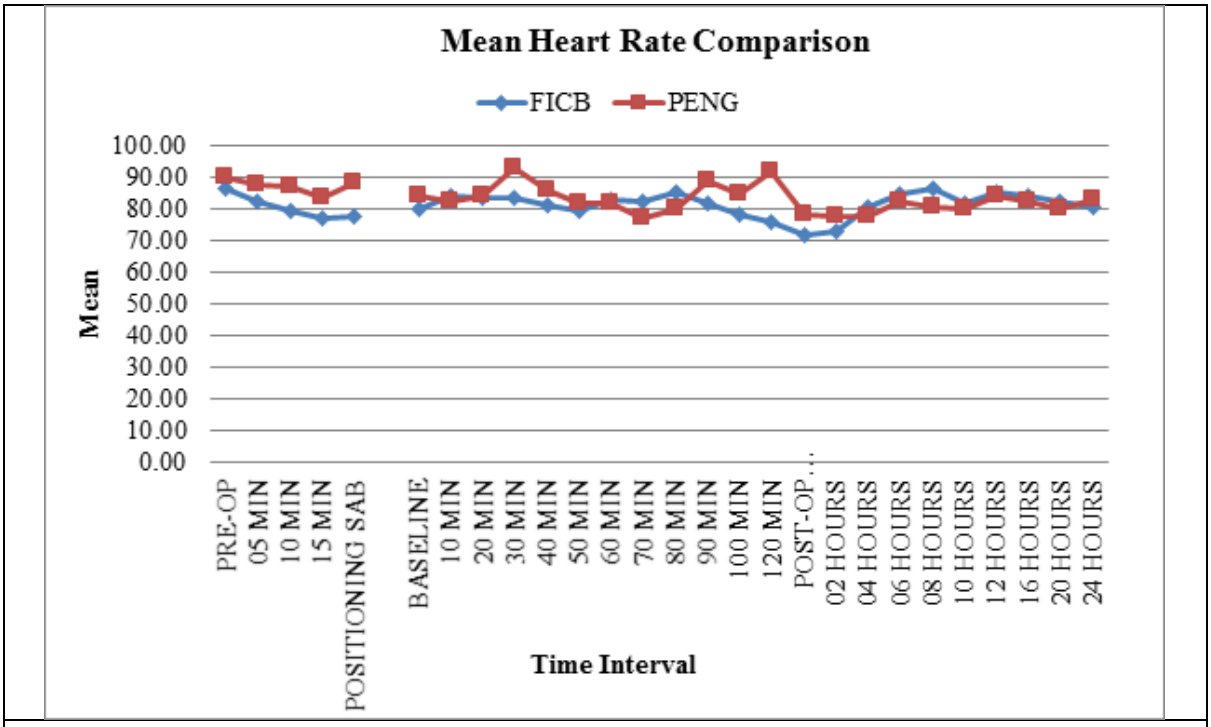

Figure 3: Line diagram showing mean heart rate comparison between two groups at different intervals of time

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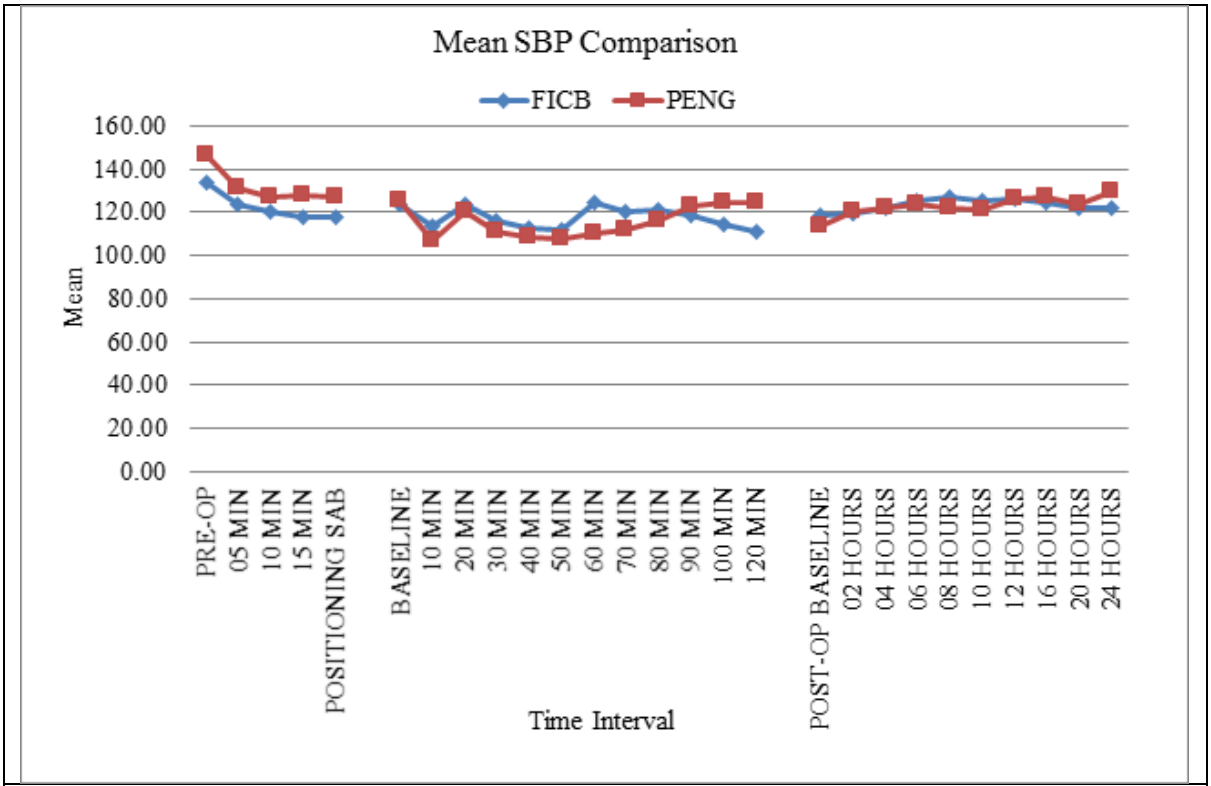

Figure 4: Line diagram showing mean SBP comparison between two groups at different intervals of time

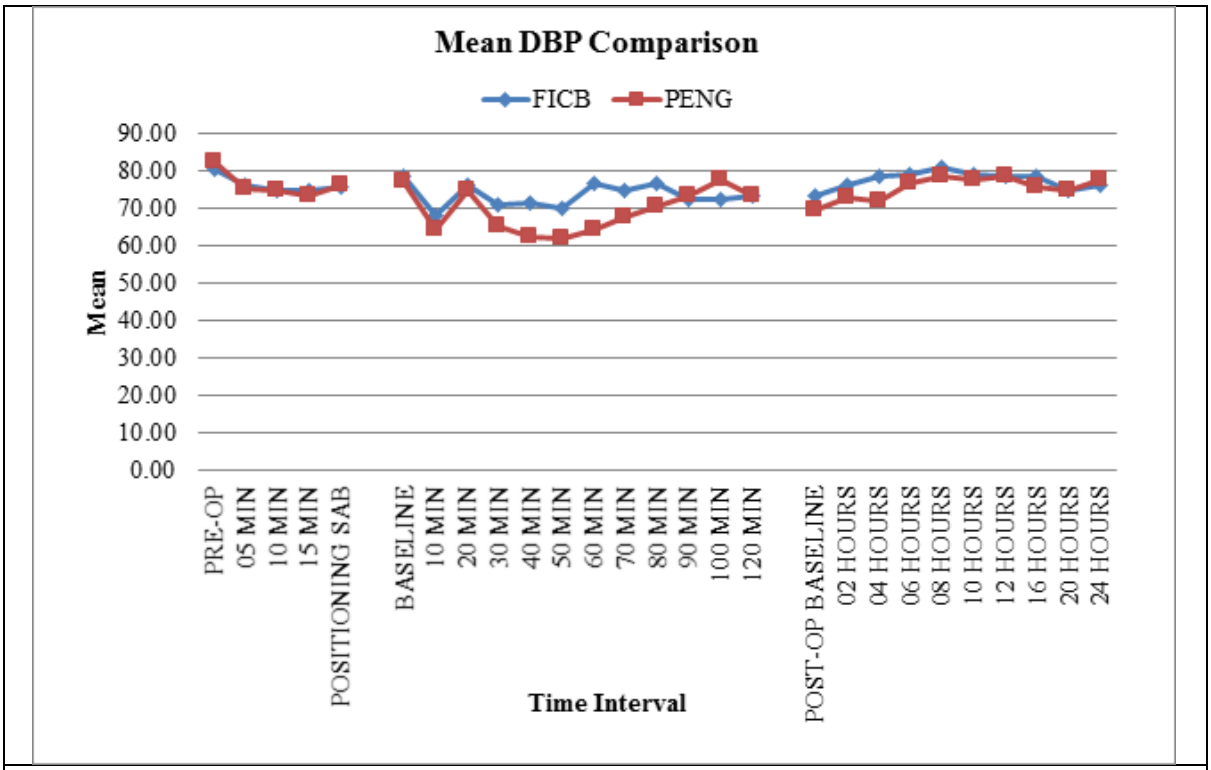

Figure 5: Line diagram showing mean DBP comparison between two groups at different intervals of time

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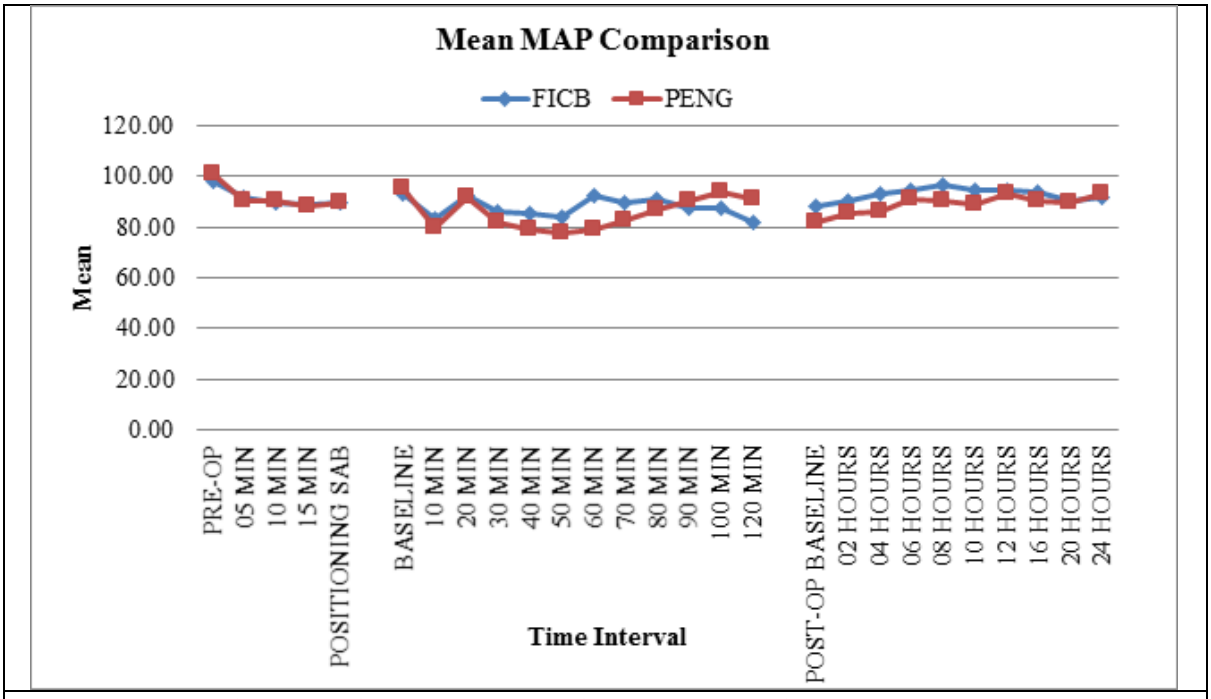

Figure 6: Line diagram showing mean MAP comparison between two groups at different intervals of time

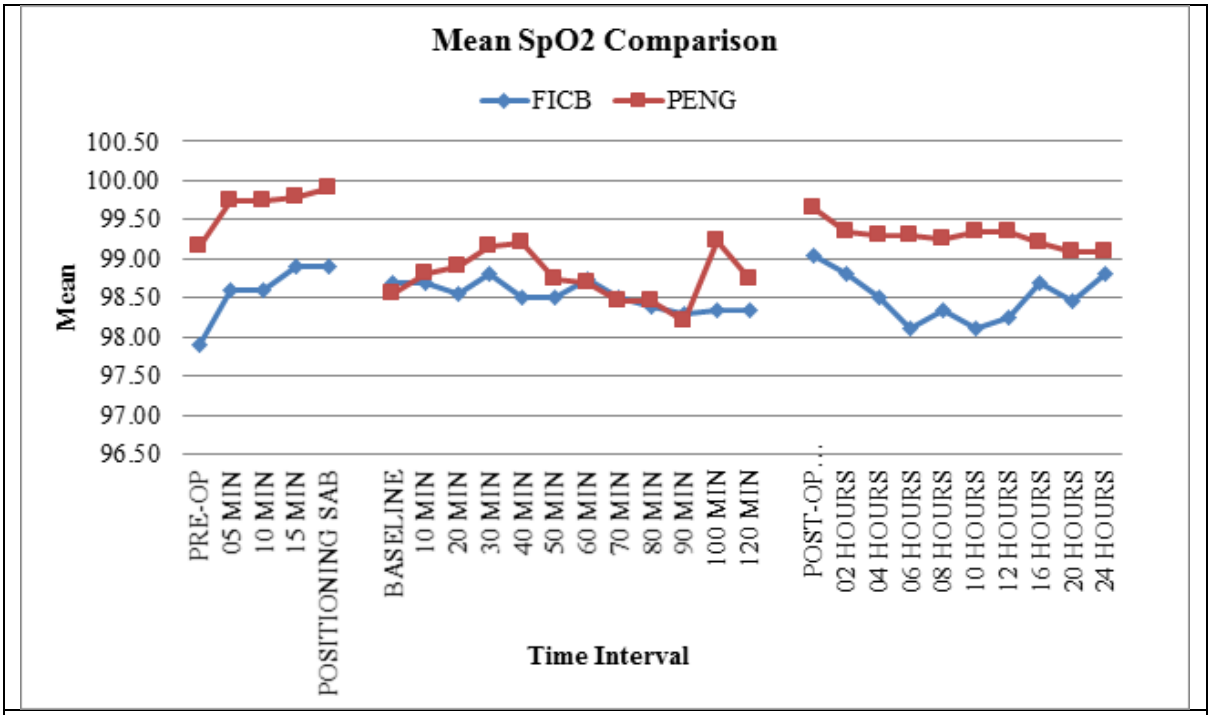

Figure 7: Line diagram showing mean SpO2 comparison between two groups at different intervals of time

Mean Total Duration of Analgesia in FICB Group was 407 ± 125.65 mins and in PENG was 566.5 ± 155.67 mins. There was a significant difference in mean Total Duration of Analgesia comparison between two groups Table 5.

	Group		p value
	FICB	PENG	

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	Mean	±SD	Mean	±SD	
Total Duration of analgesia	407.00	125.65	566.50	155.67	0.001*

Table 5: Mean Total Duration of Analgesia Comparison between two groups at different intervals of time

There was a significant difference in Total doses of Analgesia in 24 hours of block Distribution between two groups, in which 10 patients received single dose, 6 patients received two doses and remaining 4 patients received 3 doses of analgesia in FICB group and that of PENG group received two patients with single dose, 13 patients with two doses and 5 patients with 3 doses of analgesia in first 24 hours of block. None of the patients reported any block-related complications.

DISCUSSION

Femur fractures are extremely painful since the pain arises in the periosteum and is subjected to major muscle pressures that could deform the thigh and further angulate the bone pieces, making the agony worse. The intraoperative reduction of the fracture is complicated by these muscle forces. This implies that every muscle that contracts the femur must be rendered fully paralysed. In patients with hip fractures, proper posture is essential for the efficient administration of SA, which calls for sufficient analgesia. Peripheral nerve blocks are chosen over systemic opioid use since the majority of patients are elderly and have comorbid issues.

The complicated innervation of the hip joint makes it difficult to administer the optimal anaesthesia following injury and surgery, particularly in cases of hip fracture. According to research, the posterior capsule receives innervation for mechanoreceptors without sensory fibres while the anterior capsule is mostly supplied by nociceptive fibres.[14] The main source of pain following hip surgery is the heavily innervated anterior capsule of the hip joint. The femoral nerve, obturator nerve, and auxiliary obturator nerve have been the main targets of regional anaesthesia during hip procedures since they provide the neural supply of the capsule.[15] Common analgesic blocks used during spinal positioning are FICB and PENG blocks.

In the past, the FICB was frequently utilised as the most efficient block for analgesia following various hip operations, according to PROSPECT.[16] The effectiveness of FICB in inhibiting the obturator nerve, however, has come under scrutiny.[17,18] A study using magnetic resonance imaging has revealed that following FICB, the injectate distribution to the obturator nerve is restricted. These results led to the questioning of the FICB's genuine anaesthetic potential, and efforts were made to create a new block that consistently blocked all three nerves.[19] The PENG block was developed as an interfascial plane block that targets the femoral nerve, obturator nerve, and accessory obturator nerve by injecting local anaesthetic beneath the iliopsoas tendon.

Presumably, the PENG has advantages over conventional regional anaesthetic methods because it offers a more extensive and thorough sensory innervation coverage to the hip, which may reduce the need for opioids. Furthermore, the PENG block is technically feasible like other nerve blocks since its landmarks, the anterior inferior iliac spine, the psoas tendon, and the iliopubic eminence, are easily visible on USG.[20]

This study showed that PENG block provides better analgesia for optimal positioning with better patient satisfaction than Fascia iliaca block in patients undergoing surgeries for hip fractures. Our study aimed to study the efficacy of USG guided FICB technique and USG guided PENG block technique in positioning the patient for SAB and there was no significant difference in VAS scores between two groups during positioning after the block. In group

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FICB, mean VAS before block was 5.55±0.83 reduced to 0.50±0.61 during positioning and in group PENG it was 5.65±0.67 reduced to 0.75±0.72 during positioning for SAB.

In our study, we observed that both the groups PENG block and FICB does not alter the haemodynamic profile of the patients as the patients were haemodynamically stable without any significant difference in heart rate, blood pressure and oxygen saturation.

We observed that PENG block provides superior post operative analgesia than FICB, mean total duration of analgesia in FICB was 407±125.65 minutes and in PENG was 565.5±155.67 minutes. There was significant difference in mean total duration of analgesia comparison between two groups. All patients were mobilised within 6hours after surgery with improved functional recovery. No complications were noted in any patient.

By all above findings in this study of 20 patients of each group, we recommend more widespread use of USG guided FICB and PENG block has similar reduction of VAS scores in both groups. The patients' satisfaction about pain relief after the blocks was assessed and there was no significant difference in patient satisfaction score distribution between two groups during positioning for SAB.

One of the limitations of our study was assessment of VAS score which is subjective and can vary with the level of understanding between patient and anaesthesiologist.

CONCLUSION

In hip fracture surgeries, FICB and PENG block both are effective analgesia techniques for positioning, whereas PENG block technique is superior method of analgesia for post operative pain than FICB without any significant side effects.

CONFLICT OF INTEREST: Nil

FINANCIAL ASSISTANCE: Nil

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